

### **UNIT TERMINAL OBJECTIVE**

- 5-2 At the completion of this unit, the paramedic student will be able to integrate pathophysiological principles and assessment findings to formulate a field impression and implement the treatment plan for the patient with cardiovascular disease.

### **COGNITIVE OBJECTIVES**

At the completion of this unit, the paramedic student will be able to:

- 5-2.1 Describe the incidence, morbidity and mortality of cardiovascular disease. (C-1)
- 5-2.2 Discuss prevention strategies that may reduce the morbidity and mortality of cardiovascular disease. (C-1)
- 5-2.3 Identify the risk factors most predisposing to coronary artery disease. (C-1)
- 5-2.4 Describe the anatomy of the heart, including the position in the thoracic cavity, layers of the heart, chambers of the heart, and location and function of cardiac valves. (C-1)
- 5-2.5 Identify the major structures of the vascular system. (C-1)
- 5-2.6 Identify the factors affecting venous return. (C-1)
- 5-2.7 Identify and define the components of cardiac output. (C-1)
- 5-2.8 Identify phases of the cardiac cycle. (C-1)
- 5-2.9 Identify the arterial blood supply to any given area of the myocardium. (C-1)
- 5-2.10 Compare and contrast the coronary arterial distribution to the major portions of the cardiac conduction system. (C-3)
- 5-2.11 Identify the structure and course of all divisions and subdivisions of the cardiac conduction system. (C-1)
- 5-2.12 Identify and describe how the heart's pacemaking control, rate, and rhythm are determined. (C-2)
- 5-2.13 Explain the physiological basis of conduction delay in the AV node. (C-3)
- 5-2.14 Define the functional properties of cardiac muscle. (C-1)
- 5-2.15 Define the events comprising electrical potential. (C-1)
- 5-2.16 List the most important ions involved in myocardial action potential and their primary function in this process. (C-2)
- 5-2.17 Describe the events involved in the steps from excitation to contraction of cardiac muscle fibers. (C-1)
- 5-2.18 Describe the clinical significance of Starling's law. (C-3)
- 5-2.19 Identify the structures of the autonomic nervous system (ANS). (C-1)
- 5-2.20 Identify the effect of the ANS on heart rate, rhythm and contractility. (C-1)
- 5-2.21 Define and give examples of positive and negative inotropism, chronotropism and dromotropism. (C-2)
- 5-2.22 Discuss the pathophysiology of cardiac disease and injury. (C-1)
- 5-2.23 Identify and describe the details of inspection, auscultation and palpation specific to the cardiovascular system. (C-1)
- 5-2.24 Define pulse deficit, pulsus paradoxus and pulsus alternans. (C-1)
- 5-2.25 Identify the normal characteristics of the point of maximal impulse (PMI). (C-1)
- 5-2.26 Identify and define the heart sounds. (C-1)
- 5-2.27 Relate heart sounds to hemodynamic events in the cardiac cycle. (C-2)
- 5-2.28 Describe the differences between normal and abnormal heart sounds. (C-2)
- 5-2.29 Identify and describe the components of the focused history as it relates to the patient with cardiovascular compromise. (C-1)
- 5-2.30 Explain the purpose of ECG monitoring. (C-1)
- 5-2.31 Describe how ECG wave forms are produced. (C-2)
- 5-2.32 Correlate the electrophysiological and hemodynamic events occurring throughout the entire cardiac cycle with the various ECG wave forms, segments and intervals. (C-2)
- 5-2.33 Identify how heart rates, durations, and amplitudes may be determined from ECG recordings. (C-3)
- 5-2.34 Relate the cardiac surfaces or areas represented by the ECG leads. (C-2)

- 5-2.35 Given an ECG, identify the arrhythmia. (C-3)
- 5-2.36 Identify the limitations to the ECG. (C-1)
- 5-2.37 Differentiate among the primary mechanisms responsible for producing cardiac arrhythmias. (C-1)
- 5-2.38 Describe a systematic approach to the analysis and interpretation of cardiac arrhythmias. (C-2)
- 5-2.39 Describe the arrhythmias originating in the sinus node, the AV junction, the atria, and the ventricles. (C-3)
- 5-2.40 Describe the arrhythmias originating or sustained in the AV junction. (C-3)
- 5-2.41 Describe the abnormalities originating within the bundle branch system. (C-3)
- 5-2.42 Describe the process of differentiating wide QRS complex tachycardias. (C-3)
- 5-2.43 Recognize the pitfalls in the differentiation of wide QRS complex tachycardias. (C-1)
- 5-2.44 Describe the conditions of pulseless electrical activity. (C-3)
- 5-2.45 Describe the phenomena of reentry, aberration and accessory pathways. (C-1)
- 5-2.46 Identify the ECG changes characteristically produced by electrolyte imbalances and specify the clinical implications. (C-2)
- 5-2.47 Identify patient situations where ECG rhythm analysis is indicated. (C-1)
- 5-2.48 Recognize the changes on the ECG that may reflect evidence of myocardial ischemia and injury. (C-1)
- 5-2.49 Recognize the limitations of the ECG in reflecting evidence of myocardial ischemia and injury. (C-1)
- 5-2.50 Correlate abnormal ECG findings with clinical interpretation. (C-2)
- 5-2.51 Identify the major therapeutic objectives in the treatment of the patient with any arrhythmia. (C-1)
- 5-2.52 Identify the major mechanical, pharmacological and electrical therapeutic interventions. (C-3)
- 5-2.53 Based on field impressions, identify the need for rapid intervention for the patient in cardiovascular compromise. (C-3)
- 5-2.54 Describe the incidence, morbidity and mortality associated with myocardial conduction defects. (C-1)
- 5-2.55 Identify the clinical indications for transcutaneous and permanent artificial cardiac pacing. (C-1)
- 5-2.56 Describe the components and the functions of a transcutaneous pacing system. (C-1)
- 5-2.57 Explain what each setting and indicator on a transcutaneous pacing system represents and how the settings may be adjusted. (C-2)
- 5-2.58 Describe the techniques of applying a transcutaneous pacing system. (C-1)
- 5-2.59 Describe the characteristics of an implanted pacemaking system. (C-1)
- 5-2.60 Describe artifacts that may cause confusion when evaluating the ECG of a patient with a pacemaker. (C-2)
- 5-2.61 List the possible complications of pacing. (C-3)
- 5-2.62 List the causes and implications of pacemaker failure. (C-2)
- 5-2.63 Identify additional hazards that interfere with artificial pacemaker function. (C-1)
- 5-2.64 Recognize the complications of artificial pacemakers as evidenced on ECG. (C-2)
- 5-2.65 Describe the epidemiology, morbidity and mortality, and pathophysiology of angina pectoris. (C-1)
- 5-2.66 List and describe the assessment parameters to be evaluated in a patient with angina pectoris. (C-1)
- 5-2.67 Identify what is meant by the OPQRST of chest pain assessment. (C-3)
- 5-2.68 List other clinical conditions that may mimic signs and symptoms of coronary artery disease and angina pectoris. (C-1)
- 5-2.69 Identify the ECG findings in patients with angina pectoris. (C-3)
- 5-2.70 Identify the paramedic responsibilities associated with management of the patient with angina pectoris. (C-2)
- 5-2.71 Based on the pathophysiology and clinical evaluation of the patient with chest pain, list the anticipated clinical problems according to their life-threatening potential. (C-3)
- 5-2.72 Describe the epidemiology, morbidity and mortality of myocardial infarction. (C-1)
- 5-2.73 List the mechanisms by which an MI may be produced by traumatic and non-traumatic events. (C-2)
- 5-2.74 Identify the primary hemodynamic changes produced in myocardial infarction. (C-1)
- 5-2.75 List and describe the assessment parameters to be evaluated in a patient with a suspected myocardial

- infarction. (C-1)
- 5-2.76 Identify the anticipated clinical presentation of a patient with a suspected acute myocardial infarction. (C-3)
- 5-2.77 Differentiate the characteristics of the pain/ discomfort occurring in angina pectoris and acute myocardial infarction. (C-2)
- 5-2.78 Identify the ECG changes characteristically seen during evolution of an acute myocardial infarction. (C-2)
- 5-2.79 Identify the most common complications of an acute myocardial infarction. (C-3)
- 5-2.80 List the characteristics of a patient eligible for thrombolytic therapy. (C-2)
- 5-2.81 Describe the "window of opportunity" as it pertains to reperfusion of a myocardial injury or infarction. (C-3)
- 5-2.82 Based on the pathophysiology and clinical evaluation of the patient with a suspected acute myocardial infarction, list the anticipated clinical problems according to their life-threatening potential. (C-3)
- 5-2.83 Specify the measures that may be taken to prevent or minimize complications in the patient suspected of myocardial infarction. (C-3)
- 5-2.84 Describe the most commonly used cardiac drugs in terms of therapeutic effect and dosages, routes of administration, side effects and toxic effects. (C-3)
- 5-2.85 Describe the epidemiology, morbidity and mortality of heart failure. (C-1)
- 5-2.86 Define the principle causes and terminology associated with heart failure. (C-1)
- 5-2.87 Identify the factors that may precipitate or aggravate heart failure. (C-3)
- 5-2.88 Describe the physiological effects of heart failure. (C-2)
- 5-2.89 Define the term "acute pulmonary edema" and describe its relationship to left ventricular failure. (C-3)
- 5-2.90 Define preload, afterload and left ventricular end-diastolic pressure and relate each to the pathophysiology of heart failure. (C-3)
- 5-2.91 Differentiate between early and late signs and symptoms of left ventricular failure and those of right ventricular failure. (C-3)
- 5-2.92 Explain the clinical significance of paroxysmal nocturnal dyspnea. (C-1)
- 5-2.93 Explain the clinical significance of edema of the extremities and sacrum. (C-1)
- 5-2.94 List the interventions prescribed for the patient in acute congestive heart failure. (C-2)
- 5-2.95 Describe the most commonly used pharmacological agents in the management of congestive heart failure in terms of therapeutic effect, dosages, routes of administration, side effects and toxic effects. (C-1)
- 5-2.96 Define the term "cardiac tamponade". (C-1)
- 5-2.97 List the mechanisms by which cardiac tamponade may be produced by traumatic and non-traumatic events. (C-2)
- 5-2.98 Identify the limiting factor of pericardial anatomy that determines intrapericardial pressure. (C-1)
- 5-2.99 Identify the clinical criteria specific to cardiac tamponade. (C-2)
- 5-2.100 Describe how to determine if pulsus paradoxus, pulsus alternans or electrical alternans is present. (C-2)
- 5-2.101 Identify the paramedic responsibilities associated with management of a patient with cardiac tamponade. (C-2)
- 5-2.102 Describe the incidence, morbidity and mortality of hypertensive emergencies. (C-1)
- 5-2.103 Define the term "hypertensive emergency". (C-1)
- 5-2.104 Identify the characteristics of the patient population at risk for developing a hypertensive emergency. (C-1)
- 5-2.105 Explain the essential pathophysiological defect of hypertension in terms of Starling's law of the heart. (C-3)
- 5-2.106 Identify the progressive vascular changes associate with sustained hypertension. (C-1)
- 5-2.107 Describe the clinical features of the patient in a hypertensive emergency. (C-3)
- 5-2.108 Rank the clinical problems of patients in hypertensive emergencies according to their sense of urgency. (C-3)
- 5-2.109 From the priority of clinical problems identified, state the management responsibilities for the patient with a hypertensive emergency. (C-2)
- 5-2.110 Identify the drugs of choice for hypertensive emergencies, rationale for use, clinical precautions and disadvantages of selected antihypertensive agents. (C-3)

- 5-2.111 Correlate abnormal findings with clinical interpretation of the patient with a hypertensive emergency. (C-3)
- 5-2.112 Define the term "cardiogenic shock". (C-1)
- 5-2.113 Describe the major systemic effects of reduced tissue perfusion caused by cardiogenic shock. (C-3)
- 5-2.114 Explain the primary mechanisms by which the heart may compensate for a diminished cardiac output and describe their efficiency in cardiogenic shock. (C-3)
- 5-2.115 Differentiate progressive stages of cardiogenic shock. (C-3)
- 5-2.116 Identify the clinical criteria for cardiogenic shock. (C-1)
- 5-2.117 Describe the characteristics of patients most likely to develop cardiogenic shock. (C-3)
- 5-2.118 Describe the most commonly used pharmacological agents in the management of cardiogenic shock in terms of therapeutic effects, dosages, routes of administration, side effects and toxic effects. (C-2)
- 5-2.119 Correlate abnormal findings with clinical assessment of the patient in cardiogenic shock. (C-3)
- 5-2.120 Identify the paramedic responsibilities associated with management of a patient in cardiogenic shock. (C-2)
- 5-2.121 Define the term "cardiac arrest". (C-1)
- 5-2.122 Identify the characteristics of patient population at risk for developing cardiac arrest from cardiac causes. (C-1)
- 5-2.123 Identify non-cardiac causes of cardiac arrest. (C-1)
- 5-2.124 Describe the arrhythmias seen in cardiac arrest. (C-3)
- 5-2.125 Identify the critical actions necessary in caring for the patient with cardiac arrest. (C-3)
- 5-2.126 Explain how to confirm asystole using the 3-lead ECG. (C-1)
- 5-2.127 Define the terms defibrillation and synchronized cardioversion. (C-1)
- 5-2.128 Specify the methods of supporting the patient with a suspected ineffective implanted defibrillation device. (C-2)
- 5-2.129 Describe the most commonly used pharmacological agents in the managements of cardiac arrest in terms of therapeutic effects. (C-3)
- 5-2.130 Identify resuscitation. (C-1)
- 5-2.131 Identify circumstances and situations where resuscitation efforts would not be initiated. (C-1)
- 5-2.132 Identify and list the inclusion and exclusion criteria for termination of resuscitation efforts. (C-1)
- 5-2.133 Identify communication and documentation protocols with medical direction and law enforcement used for termination of resuscitation efforts. (C-1)
- 5-2.134 Describe the incidence, morbidity and mortality of vascular disorders. (C-1)
- 5-2.135 Describe the pathophysiology of vascular disorders. (C-1)
- 5-2.136 List the traumatic and non-traumatic causes of vascular disorders. (C-1)
- 5-2.137 Define the terms "aneurysm", "claudication" and "phlebitis". (C-1)
- 5-2.138 Identify the peripheral arteries most commonly affected by occlusive disease. (C-1)
- 5-2.139 Identify the major factors involved in the pathophysiology of aortic aneurysm. (C-1)
- 5-2.140 Recognize the usual order of signs and symptoms that develop following peripheral artery occlusion. (C-3)
- 5-2.141 Identify the clinical significance of claudication and presence of arterial bruits in a patient with peripheral vascular disorders. (C-3)
- 5-2.142 Describe the clinical significance of unequal arterial blood pressure readings in the arms. (C-3)
- 5-2.143 Recognize and describe the signs and symptoms of dissecting thoracic or abdominal aneurysm. (C-3)
- 5-2.144 Describe the significant elements of the patient history in a patient with vascular disease. (C-2)
- 5-2.145 Identify the hemodynamic effects of vascular disorders. (C-1)
- 5-2.146 Identify the complications of vascular disorders. (C-1)
- 5-2.147 Identify the Paramedic's responsibilities associated with management of patients with vascular disorders. (C-2)
- 5-2.148 Develop, execute and evaluate a treatment plan based on the field impression for the patient with vascular disorders. (C-3)

- 5-2.149 Differentiate between signs and symptoms of cardiac tamponade, hypertensive emergencies, cardiogenic shock, and cardiac arrest. (C-3)
- 5-2.150 Based on the pathophysiology and clinical evaluation of the patient with chest pain, characterize the clinical problems according to their life-threatening potential. (C-3)
- 5-2.151 Apply knowledge of the epidemiology of cardiovascular disease to develop prevention strategies. (C-3)
- 5-2.152 Integrate pathophysiological principles into the assessment of a patient with cardiovascular disease. (C-3)
- 5-2.153 Apply knowledge of the epidemiology of cardiovascular disease to develop prevention strategies. (C-3)
- 5-2.154 Integrate pathophysiological principles into the assessment of a patient with cardiovascular disease. (C-3)
- 5-2.155 Synthesize patient history, assessment findings and ECG analysis to form a field impression for the patient with cardiovascular disease. (C-3)
- 5-2.156 Integrate pathophysiological principles to the assessment of a patient in need of a pacemaker. (C-1)
- 5-2.157 Synthesize patient history, assessment findings and ECG analysis to form a field impression for the patient in need of a pacemaker. (C-3)
- 5-2.158 Develop, execute, and evaluate a treatment plan based on field impression for the patient in need of a pacemaker. (C-3)
- 5-2.159 Based on the pathophysiology and clinical evaluation of the patient with chest pain, characterize the clinical problems according to their life-threatening potential. (C-3)
- 5-2.160 Integrate pathophysiological principles to the assessment of a patient with chest pain. (C-3)
- 5-2.161 Synthesize patient history, assessment findings and ECG analysis to form a field impression for the patient with angina pectoris. (C-3)
- 5-2.162 Develop, execute and evaluate a treatment plan based on the field impression for the patient with chest pain. (C-3)
- 5-2.163 Integrate pathophysiological principles to the assessment of a patient with a suspected myocardial infarction. (C-3)
- 5-2.164 Synthesize patient history, assessment findings and ECG analysis to form a field impression for the patient with a suspected myocardial infarction. (C-3)
- 5-2.165 Develop, execute and evaluate a treatment plan based on the field impression for the suspected myocardial infarction patient. (C-3)
- 5-2.166 Integrate pathophysiological principles to the assessment of the patient with heart failure. (C-3)
- 5-2.167 Synthesize assessment findings and patient history information to form a field impression of the patient with heart failure. (C-3)
- 5-2.168 Develop, execute, and evaluate a treatment plan based on the field impression for the heart failure patient. (C-3)
- 5-2.169 Integrate pathophysiological principles to the assessment of a patient with cardiac tamponade. (C-3)
- 5-2.170 Synthesize assessment findings and patient history information to form a field impression of the patient with cardiac tamponade. (C-3)
- 5-2.171 Develop, execute and evaluate a treatment plan based on the field impression for the patient with cardiac tamponade. (C-3)
- 5-2.172 Integrate pathophysiological principles to the assessment of the patient with a hypertensive emergency. (C-3)
- 5-2.173 Synthesize assessment findings and patient history information to form a field impression of the patient with a hypertensive emergency. (C-3)
- 5-2.174 Develop, execute and evaluate a treatment plan based on the field impression for the patient with a hypertensive emergency. (C-3)
- 5-2.175 Integrate pathophysiological principles to the assessment of the patient with cardiogenic shock. (C-3)
- 5-2.176 Synthesize assessment findings and patient history information to form a field impression of the patient with cardiogenic shock. (C-3)
- 5-2.177 Develop, execute, and evaluate a treatment plan based on the field impression for the patient with

- cardiogenic shock. (C-3)
- 5-2.178 Integrate the pathophysiological principles to the assessment of the patient with cardiac arrest. (C-3)
- 5-2.179 Synthesize assessment findings to formulate a rapid intervention for a patient in cardiac arrest. (C-3)
- 5-2.180 Synthesize assessment findings to formulate the termination of resuscitative efforts for a patient in cardiac arrest. (C-3)
- 5-2.181 Integrate pathophysiological principles to the assessment of a patient with vascular disorders. (C-3)
- 5-2.182 Synthesize assessment findings and patient history to form a field impression for the patient with vascular disorders. (C-3)
- 5-2.183 Integrate pathophysiological principles to the assessment and field management of a patient with chest pain. (C-3)

### **AFFECTIVE OBJECTIVES**

At the completion of this unit, the paramedic student will be able to:

- 5-2.184 Value the sense of urgency for initial assessment and intervention in the patient with cardiac compromise. (A-3)
- 5-2.185 Value and defend the sense of urgency necessary to protect the window of opportunity for reperfusion in the patient with suspected myocardial infarction. (A-3)
- 5-2.186 Defend patient situations where ECG rhythm analysis is indicated. (A-3)
- 5-2.187 Value and defend the application of transcutaneous pacing system. (A-3)
- 5-2.188 Value and defend the urgency in identifying pacemaker malfunction. (A-3)
- 5-2.189 Based on the pathophysiology and clinical evaluation of the patient with acute myocardial infarction, characterize the clinical problems according to their life-threatening potential. (A-3)
- 5-2.190 Defend the measures that may be taken to prevent or minimize complications in the patient with a suspected myocardial infarction. (A-3)
- 5-2.191 Defend the urgency based on the severity of the patient's clinical problems in a hypertensive emergency. (A-3)
- 5-2.192 From the priority of clinical problems identified, state the management responsibilities for the patient with a hypertensive emergency. (A-3)
- 5-2.193 Value and defend the urgency in rapid determination of and rapid intervention of patients in cardiac arrest. (A-3)
- 5-2.194 Value and defend the possibility of termination of resuscitative efforts in the out-of-hospital setting. (A-3)
- 5-2.195 Based on the pathophysiology and clinical evaluation of the patient with vascular disorders, characterize the clinical problems according to their life-threatening potential. (A-3)
- 5-2.196 Value and defend the sense of urgency in identifying peripheral vascular occlusion. (A-3)
- 5-2.197 Value and defend the sense of urgency in recognizing signs of aortic aneurysm. (A-3)

### **PSYCHOMOTOR OBJECTIVES**

At the completion of this unit, the paramedic student will be able to:

- 5-2.198 Demonstrate how to set and adjust the ECG monitor settings to varying patient situations. (P-3)
- 5-2.199 Demonstrate a working knowledge of various ECG lead systems. (P-3)
- 5-2.200 Demonstrate how to record an ECG. (P-2)
- 5-2.201 Perform, document and communicate a cardiovascular assessment. (P-1)
- 5-2.202 Set up and apply a transcutaneous pacing system. (P-3)
- 5-2.203 Given the model of a patient with signs and symptoms of heart failure, position the patient to afford comfort and relief. (P-2)
- 5-2.204 Demonstrate how to determine if pulsus paradoxus, pulsus alternans or electrical alternans is present. (P-

- 2)
- 5-2.205 Demonstrate satisfactory performance of psychomotor skills of basic and advanced life support techniques according to the current American Heart Association Standards and Guidelines, including: (P-3)
- a. Cardiopulmonary resuscitation
  - b. Defibrillation
  - c. Synchronized cardioversion
  - d. Transcutaneous pacing
- 5-2.206 Complete a communication patch with medical direction and law enforcement used for termination of resuscitation efforts. (P-1)
- 5-2.207 Demonstrate how to evaluate major peripheral arterial pulses. (P-1)

## DECLARATIVE

- I. Introduction
  - A. Epidemiology
    - 1. Incidence
      - a. Prevalence of cardiac death outside of a hospital
        - (1) Supportive statistics
      - b. Prevalence of prodromal signs and symptoms
        - (1) Supportive statistics
      - c. Increased recognition of need for early reperfusion
    - 2. Morbidity/ mortality
      - a. Reduced with early recognition
      - b. Reduced with early access to EMS system
    - 3. Risk factors
      - a. Age
      - b. Family history
      - c. Hypertension
      - d. Lipids
        - (1) Hypercholesterolemia
      - e. Male sex
      - f. Smoking
      - g. Carbohydrate intolerance
    - 4. Possible contributing risks
      - a. Diet
      - b. Female sex
      - c. Obesity
      - d. Oral contraceptives
      - e. Sedentary living
      - f. Personality type
      - g. Psychosocial tensions
    - 5. Prevention strategies
      - a. Early recognition
      - b. Education
      - c. Alteration of life style
  - B. Cardiovascular anatomy and physiology
    - 1. Anatomy of the heart
    - 2. Location
      - a. Layers
        - (1) Myocardium
        - (2) Endocardium
        - (3) Pericardium
          - (a) Visceral (epicardium)
          - (b) Parietal
      - b. Chambers
        - (1) Atria
        - (2) Ventricles
      - c. Valves
        - (1) Atrioventricular (AV) valves

- (a) Tricuspid (right)
      - (b) Mitral (left)
    - (2) Semilunar valves
      - (a) Pulmonary (right)
      - (b) Aortic (left)
  - d. Papillary muscles
  - e. Chordae tendineae
- 3. Cardiac cycle
  - a. Phases
    - (1) Systole
      - (a) Atrial
      - (b) Ventricular
    - (2) Diastole
      - (a) Atrial
      - (b) Ventricular
  - b. Cardiac output
    - (1) Stroke volume
      - (a) Heart rate
      - (b) Contractility
      - (c) Starling's law
- 4. Vascular system
  - a. Aorta
    - (1) Ascending
    - (2) Thoracic
    - (3) Abdominal
  - b. Arteries
  - c. Arterioles
  - d. Capillaries
  - e. Venule
  - f. Veins
  - g. Vena cava
    - (1) Superior
    - (2) Inferior
  - h. Venous return (preload)
    - (1) Skeletal muscle pump
    - (2) Thoracoabdominal pump
    - (3) Respiratory cycle
    - (4) Gravity
    - (5) IPPB, PEEP, CPAP, BiPAP
  - i. Resistance and capacitance (afterload)
  - j. Pulmonary veins
- 5. Coronary circulation
  - a. Arteries
    - (1) Left coronary artery
      - (a) Anterior descending branch (LAD)
        - i) Distribution to the conduction system
      - (b) Circumflex
        - i) Distribution to the conduction system

- (2) Right coronary artery
  - (a) Distribution to the conduction system
- b. Veins
  - (1) Coronary sinus
  - (2) Great cardiac vein
- 6. Electrophysiology
  - a. Conduction system overview
    - (1) Sinoatrial node or sinus node (SA node)
    - (2) Atrioventricular (AV) junction
      - (a) AV node
      - (b) Bundle of His
    - (3) His-Purkinje system
      - (a) Bundle branches
        - i) Right
        - ii) Left anterior fascicle
        - iii) Left posterior fascicle
    - (4) Characteristics of myocardial cells
      - (a) Automaticity
      - (b) Excitability
      - (c) Conductivity
      - (d) Contractility
  - b. Electrical potential
    - (1) Action potential
      - (a) Important electrolytes
        - i) Sodium
        - ii) Potassium
        - iii) Calcium
        - iv) Chloride
        - v) Magnesium
    - (2) Excitability
      - (a) Thresholds
      - (b) Depolarization
      - (c) Repolarization
        - i) Relative refractory period
        - ii) Absolute refractory period
    - (3) Neurotransmitters
      - (a) Acetylcholine
        - i) Effects on myocardium
        - ii) Effects on systemic blood vessels
      - (b) Cholinesterase
        - i) Effects on myocardium
        - ii) Effects on systemic blood vessels
  - c. Autonomic nervous system relationship to cardiovascular system
    - (1) Medulla
    - (2) Carotid sinus and baroreceptor
      - (a) Location
      - (b) Significance
    - (3) Parasympathetic system

- (4) Sympathetic
    - (a) Alpha - vasoconstrictive effect on systemic blood vessels
    - (b) Beta
      - i) Inotropic effect on myocardium
      - ii) Dromotropic effect on myocardium
      - iii) Chronotropic effect on myocardium
  - (5) Systemic circulation
- II. Initial cardiovascular assessment
- A. Level of responsiveness
  - B. Airway
    - 1. Patent
    - 2. Debris, blood
  - C. Breathing
    - 1. Absent
    - 2. Present
      - a. Rate and depth
        - (1) Effort
        - (2) Breath sounds
          - (a) Characteristics
          - (b) Significance
  - D. Circulation
    - 1. Pulse
      - a. Absent
      - b. Present
        - (1) Rate and quality
          - (a) Pulse deficit
          - (b) Pulsus paradoxus
          - (c) Pulsus alternans
    - 2. Skin
      - a. Color
      - b. Temperature
      - c. Moisture
      - d. Turgor
      - e. Mobility
      - f. Edema
    - 3. Blood pressure
- III. Focused history
- A. H and physical/ SAMPLE format
    - 1. Chief complaint
    - 2. Pain
      - a. OPQRST
        - (1) Onset/ origin
          - (a) Pertinent past history
          - (b) Time of onset
        - (2) Provocation
          - (a) Exertional

- (b) Non-exertional
  - (3) Quality
    - (a) Patient's narrative description
      - i) For example - sharp, tearing, pressure, heaviness
  - (4) Region/ radiation
    - (a) For example - arms, neck, back
  - (5) Severity
    - (a) "1-10" scale
  - (6) Timing
    - (a) Duration
    - (b) Worsening or improving
    - (c) Continuous or intermittent
    - (d) At rest or with activity
- 3. Dyspnea
  - a. Continuous or intermittent
  - b. Exertional
  - c. Non-exertional
  - d. Orthopneic
- 4. Cough
  - a. Dry
  - b. Productive
- 5. Related signs and symptoms
  - a. Level of consciousness
  - b. Diaphoresis
  - c. Restlessness, anxiety
  - d. Feeling of impending doom
  - e. Nausea/ vomiting
  - f. Fatigue
  - g. Palpitations
  - h. Edema
    - (1) Extremities
    - (2) Sacral
  - i. Headache
  - j. Syncope
  - k. Behavioral change
  - l. Anguished facial expression
  - m. Activity limitations
  - n. Trauma
- 6. Past medical history
  - a. Coronary artery disease (CAD)
  - b. Atherosclerotic heart disease
    - (1) Angina
    - (2) Previous MI
    - (3) Hypertension
    - (4) Congestive heart failure (CHF)
  - c. Valvular disease
  - d. Aneurysm
  - e. Pulmonary disease

- f. Diabetes
- g. Renal disease
- h. Vascular disease
- i. Inflammatory cardiac disease
- j. Previous cardiac surgery
- k. Congenital anomalies
- l. Current/ past medications
  - (1) Prescribed
    - (a) Compliance
    - (b) Non-compliance
  - (2) Borrowed
  - (3) Over-the-counter
  - (4) Recreational
    - (a) For example - cocaine
- m. Allergies
- n. Family history
  - (1) Stroke, heart disease, diabetes, hypertension
  - (2) Age at death
- o. Known cholesterol levels

IV. Detailed physical examination

A. Inspection

- 1. Tracheal position
  - a. Neck veins
    - (1) Appearance
    - (2) Pressure
    - (3) Clinical significance
  - b. Thorax
    - (1) Configuration
      - (a) A-P diameter
      - (b) Movement with respirations
    - (2) Clinical significance
  - c. Epigastrium
    - (a) Pulsation
    - (1) Distention
    - (2) Clinical significance

B. Auscultation

- 1. Neck
  - a. Normal
  - b. Abnormal
    - (1) Bruit
- 2. Breath sounds
  - a. Depth
  - b. Equality
  - c. Adventitious sounds
    - (1) Crackles
    - (2) Wheezes
      - (a) Gurgling

- (b) Frothing (mouth and nose)
            - i) Blood tinged
            - ii) Foamy
  - 3. Heart sounds
    - a. Auscultatory sites
    - b. Identify S<sub>1</sub>, S<sub>2</sub>
- C. Palpation
  - 1. Areas of crepitus or tenderness
  - 2. Thorax
  - 3. Epigastrium
    - a. Pulsation
    - b. Distention
- V. Electrocardiographic (ECG) monitoring
  - A. Electrophysiology and wave forms
    - 1. Origination
    - 2. Production
    - 3. Relationship of cardiac events to wave forms
    - 4. Intervals
      - a. Normal
      - b. Clinical significance
    - 5. Segments
  - B. Leads and electrodes
    - 1. Electrode
    - 2. Leads
      - a. Anatomic positions
      - b. Correct placement
    - 3. Surfaces of heart and lead systems
      - a. Inferior
      - b. Left lateral
      - c. Anterior/ posterior
    - 4. Artifact
  - C. Standardization
    - 1. Amplitude
    - 2. Height
    - 3. Rate
      - a. Duration
      - b. Wave form
      - c. Segment
      - d. Complex
      - e. Interval
  - D. Wave form analysis
    - 1. Isoelectric
    - 2. Positive
    - 3. Negative
    - 4. Calculation of ECG heart rate
      - a. Regular rhythm
        - (1) ECG strip method
        - (2) "300" method

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- b. Irregular rhythm
    - (1) ECG strip method
    - (2) "300" method
  - E. Lead systems and heart surfaces
    - 1. ECG rhythm analysis
      - a. Value
      - b. Limitations
    - 2. Heart surfaces
      - a. Inferior
      - b. Left lateral
      - c. Precordial
    - 3. Acute signs of ischemia, injury and necrosis
      - a. Rationale
        - (1) Possible early identification of patients with acute myocardial infarction for intervention (thrombolysis or PTCA)
        - (2) The role of out-of-hospital twelve-lead ECG is still unresolved and may not be appropriate in many EMS settings
        - (3) EMS medical directors will make decisions regarding the application and use of the 12-lead ECG in their specific EMS setting
      - b. Advantages/ disadvantages
      - c. ST segment elevation
        - (1) Height, depth and contour
        - (2) ST (acute changes)
          - (a) Anterior wall
            - i) Significant ST elevation in V<sub>1</sub>- V<sub>4</sub> may indicate anterior involvement
          - (b) Inferior wall
            - i) Significant ST elevation in II, III and aVF may indicate inferior involvement
        - (3) ST segment depression in eight or more leads
        - (4) ST segment elevation in aVR and V<sub>1</sub>
      - d. Q waves
        - (1) Depth, duration and significance
          - (a) Greater than 5 mm, greater than .04 seconds
          - (b) May indicate necrosis
          - (c) May indicate extensive transient ischemia
  - F. Cardiac arrhythmias
    - 1. Approach to analysis
      - a. P wave
        - (1) Configuration
        - (2) Duration
        - (3) Atrial rate and rhythm
      - b. P-R (P-Q) interval
        - (1) Duration
      - c. QRS complex
        - (1) Configuration
        - (2) Duration
        - (3) Ventricular rate and rhythm

- d. S-T segment
  - (1) Contour
  - (2) Elevation
  - (3) Depression
- e. Q-T interval
  - (1) Duration
  - (2) Implication of prolongation
- f. Relationship of P waves to QRS complexes
  - (1) Consistent
  - (2) Progressive prolongation
  - (3) No relationship
- g. T waves
- h. U waves
- 2. Interpretation of the ECG
  - a. Origin of complex
  - b. Rate
  - c. Rhythm
  - d. Clinical significance
- 3. Arrhythmia originating in the sinus node
  - a. Sinus bradycardia
  - b. Sinus tachycardia
  - c. Sinus arrhythmia
  - d. Sinus arrest
- 4. Arrhythmias originating in the atria
  - a. Premature atrial complex
  - b. Atrial (ectopic) tachycardia
  - c. Re-entrant tachycardia
  - d. Multifocal atrial tachycardia
  - e. Atrial flutter
  - f. Atrial fibrillation
  - g. Atrial flutter or atrial fibrillation with junctional rhythm
  - h. Atrial flutter or atrial fibrillation with pre-excitation syndromes
- 5. Arrhythmias originating within the AV junction
  - a. First degree AV block
  - b. Second degree AV block
    - (1) Type I
    - (2) Type II/ infranodal
  - c. Complete AV block (third degree block)
- 6. Arrhythmias sustained or originating in the AV junction
  - a. AV nodal re-entrant tachycardia
  - b. AV reciprocating tachycardia
    - (1) Narrow
    - (2) Wide
  - c. Junctional escape rhythm
  - d. Premature junctional complex
  - e. Accelerated junctional rhythm
  - f. Junctional tachycardia
- 7. Arrhythmias originating in the ventricles

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- a. Idioventricular rhythm
  - b. Accelerated idioventricular rhythm
  - c. Premature ventricular complex (ventricular ectopic)
    - (1) R on T phenomenon
    - (2) Paired/ couplets
    - (3) Multifomed
    - (4) Frequent uniform
  - d. "Rule of bigeminy" pertaining to precipitating ventricular arrhythmias
  - e. Ventricular tachycardia
    - (1) Monomorphic
    - (2) Polymorphic (including torsades de pointes)
  - f. Ventricular fibrillation
  - g. Ventricular standstill
  - h. Asystole
8. Abnormalities originating within the bundle branch system
- a. Incomplete or complete
  - b. Right bundle branch block
  - c. Left bundle branch block
9. Differentiation of wide QRS complex tachycardia
- a. Potential causes
    - (1) Supraventricular tachycardia with bundle branch block
    - (2) Accessory pathways
  - b. Differentiation
    - (1) Physical evaluation
      - (a) Cannon "A" waves
      - (b) Vary intensity of first heart tone
      - (c) Beat to beat changes in blood pressure
    - (2) ECG differences
      - (a) Aberration as a result of premature atrial complex
        - i) Identify PAC in previous ST segment or T wave
        - ii) Sudden change in rate with bundle branch aberration
        - iii) Concealed retrograde conduction
        - iv) Right bundle branch refractoriness - may be time dependent
        - v) Compare with previous ECG, when available
      - (b) RBBB aberration - V<sub>1</sub> - positive
        - i) Biphasic lead I with a broad terminal S-wave
        - ii) Triphasic QRS in V<sub>4</sub>
      - (c) LBBB aberration - V<sub>1</sub> - negative
        - i) Monophasic notched lead I
        - ii) Slurred, notched or RSr' in lead V<sub>4</sub>, V<sub>5</sub>, or V<sub>6</sub>
      - (d) Concordant precordial pattern
        - i) Totally negative precordial pattern is diagnostic of ventricular tachycardia
        - ii) Totally positive precordial pattern is suggestive of ventricular tachycardia
      - (e) Preexisting BBB prior to onset of tachycardia (by history)
    - (3) Other considerations

- (a) When in doubt
    - i) Cardioversion when hemodynamic state is compromised or changing
    - ii) Never use verapamil
    - iii) If hemodynamic state is stable - consider lidocaine
  - (b) Pitfalls
    - i) Age is not a differential
    - ii) Slower rates may present with stable hemodynamic
    - iii) Preexisting BBB prior to onset of the tachycardia
  - (c) Regularity
    - i) Monomorphic V-tach and SVT are usually very regular and SVT frequently is faster
    - ii) Polymorphic V-tach is irregular
- 10. Pulseless electrical activity
    - a. Electrical mechanical dissociation
    - b. Mechanical impairments to pulsations/ cardiac output
    - c. Other possible causes
  - 11. Other ECG phenomena
    - a. Accessory pathways
    - b. Preexcitation phenomenon
    - c. Aberration versus ectopy
  - 12. ECG changes due to electrolyte imbalances
    - a. Hyperkalemia
    - b. Hypokalemia
  - 13. ECG changes in hypothermia

VI. Management of the patient with arrhythmias

- A. Assessment
  - 1. Symptomatic
  - 2. Hypotensive
  - 3. Hypoperfusion
  - 4. Mechanical
  - 5. Vagal maneuvers - if the heart rate is too fast
  - 6. Stimulation - If heart rate is too slow
  - 7. Precordial thump
  - 8. Cough
- B. Pharmacological
  - 1. Gases
    - a. Such as oxygen
  - 2. Sympathetic
    - a. Such as epinephrine
  - 3. Anticholinergic
    - a. Such as atropine
  - 4. Antiarrhythmic
    - a. Such as lidocaine
  - 5. Beta blocker
    - a. Selective
      - (1) Such as metoprolol

- b. Non-selective
    - (1) Such as propranolol
  - 6. Vasopressor
    - a. Such as dopamine
  - 7. Calcium channel blocker
    - a. Such as verapamil
  - 8. Purine nucleoside
    - a. Such as adenosine
  - 9. Platelet aggregate inhibitor
    - a. Such as aspirin
  - 10. Alkalinizing agents
    - a. Such as sodium bicarbonate
  - 11. Cardiac glycoside
    - a. Such as digitalis
  - 12. Narcotic/ analgesic
    - a. Such as morphine
  - 13. Diuretic
    - a. Such as furosemide
  - 14. Nitrate
    - a. Such as nitroglycerin
  - 15. Antihypertensive
    - a. Such as sodium nitroprusside
- C. Electrical
- 1. Purpose
  - 2. Methods
    - a. Synchronized cardioversion
    - b. Defibrillation
    - c. Cardiac pacing
      - (1) Implanted pacemaker functions
        - (a) Characteristics
        - (b) Pacemaker artifact
        - (c) ECG tracing of capture
        - (d) Failure to sense
          - i) ECG indications
          - ii) Clinical significance
        - (e) Failure to capture
          - i) ECG indications
          - ii) Clinical significance
        - (f) Failure to pace
          - i) ECG indications
          - ii) Clinical significance
        - (g) Pacer-induced tachycardia
          - i) ECG findings
          - ii) Clinical significance
          - iii) Treatment
      - (2) Transcutaneous pacing
        - (a) Criteria for use
        - (b) Bradycardia

- i) Patient is hypotensive/ hypoperfusing
        - ii) No change with pharmacologic intervention
      - (c) Second degree AV block
        - i) Patient is hypotensive/ hypoperfusing
        - ii) No change with pharmacologic intervention
      - (d) Complete AV block
        - i) Patient is hypotensive/ hypoperfusing
        - ii) No change with pharmacologic intervention
      - (e) Asystole
      - (f) Overdrive
        - i) Deter occurrence of recurrent tachycardia
    - d. Set-up
      - (1) Placement of electrodes
      - (2) Rate and milliampere (mA) settings
      - (3) Pacer artifact
      - (4) Capture
      - (5) Failure to sense
        - (a) Causes
        - (b) Implications
        - (c) Interventions
      - (6) Failure to capture
        - (a) Causes
        - (b) Implications
        - (c) Interventions
      - (7) Failure to pace
        - (a) Causes
        - (b) Implications
        - (c) Interventions
      - (8) Hazards
      - (9) Complications
        - (a) Interventions
  - D. Transport
    - 1. Indications for rapid transport
    - 2. Indications for no transport required
    - 3. Indications for referral
  - E. Support and communications strategies
    - 1. Explanation for patient, family, significant others
    - 2. Communications and transfer of data to the physician
- VII. Angina pectoris
  - A. Epidemiology
    - 1. Precipitating causes
      - a. Atherosclerosis
      - b. Vasospastic (Prinzmetal's)
  - B. Morbidity/ mortality
    - 1. Not a self-limiting disease
    - 2. Chest pain may dissipate, but myocardial ischemia and injury can continue
    - 3. A single anginal episode may be a precursor to myocardial infarction

4. May not be cardiac in origin
  5. Must be diagnosed by a physician
  6. Related terminology
    - a. Defined as a brief discomfort, has predictable characteristics and is relieved promptly - no change in this pattern
    - b. Stable
      - (1) Occurs at a relative fixed frequency
      - (2) Usually relieved by rest and/ or medication
    - c. Unstable
      - (1) Occurs without fixed frequency
      - (2) May or may not be relieved by rest and/ or medication
    - d. Initial - first episode
    - e. Progressive - accelerating in frequency and duration
    - f. Preinfarction angina
      - (1) Pain at rest
      - (2) Sitting or lying down
  7. Differential diagnoses
    - a. Cholecystitis
    - b. Acute viral pericarditis or any other inflammatory cardiac disease
    - c. Aneurysm
    - d. Hiatal hernia
    - e. Esophageal disease
    - f. Gastric reflux
    - g. Pulmonary embolism
    - h. Peptic ulcer disease
    - i. Pancreatitis
    - j. Chest wall syndrome
    - k. Costochondritis
    - l. Acromioclavicular disease
    - m. Pleural irritation
    - n. Respiratory infections
    - o. Aortic dissection
    - p. Pneumothorax
    - q. Dyspepsia
    - r. Herpes zoster
    - s. Chest wall tumors
    - t. Chest wall trauma
- C. Initial assessment findings
1. Airway/ breathing
    - a. Labored breathing may or may not be present
  2. Circulation
    - a. Peripheral pulses
      - (1) Quality
      - (2) Rhythm
    - b. Changes in skin
      - (1) Color
      - (2) Temperature
      - (3) Moisture

- D. Focused history
  - 1. Chief complaint
    - a. Typical - sudden onset of discomfort, usually of brief duration, lasting three to five minutes, maybe five to 15 minutes; never 30 minutes to two hours
    - b. Typical - usually relieved by rest and/ or medication
    - c. Epigastric pain or discomfort
    - d. Atypical
  - 2. Denial
  - 3. Contributing history
    - a. Initial recognized event
    - b. Recurrent event
    - c. Increasing frequency and/ or duration of event
- E. Detailed physical exam
  - 1. Airway
  - 2. Breathing
    - a. May or may not be labored
      - (1) Sounds
        - (a) May be clear to auscultation
        - (b) May be congested in the bases
  - 3. Circulation
    - a. Alterations in heart rate and rhythm may occur
    - b. Peripheral pulses are usually not affected
    - c. Blood pressure may be elevated during the episode and normalize afterwards
    - d. ECG Devices
      - (1) Monitor
      - (2) Transmission
      - (3) Documentation
      - (4) Computerized pattern identification
        - (a) Pitfalls
        - (b) Common errors
    - e. Findings
      - (1) ST segment changes are often not specific
      - (2) Arrhythmias and ectopy may not be present
- F. Management
  - 1. Position of comfort
  - 2. Pharmacological
    - a. Gases
    - b. Nitrates
    - c. Analgesics
    - d. Possible antiarrhythmic
    - e. Possible antihypertensives
  - 3. ECG
    - a. Whenever possible, and scene time is not delayed, record and transmit 3-lead and/ or 12-lead ECG during pain, since ECG may be normal during the pain-free period
    - b. Measure, record and communicate ST segment changes
  - 4. Transport
    - a. Indications for rapid transport

- (1) Sense of urgency for reperfusion
      - (2) No relief with medications
      - (3) Hypotension/ hypoperfusion
      - (4) Significant changes in ECG
    - b. No transport
      - (1) Patient refusal
      - (2) Referral
  - G. Support and communications strategies
    - 1. Explanation for patient, family, significant others
    - 2. Communications and transfer of data to the physician
- VIII. Myocardial infarction
  - A. Epidemiology
    - 1. Precipitating causes (as with angina)
      - a. Atherosclerosis
      - b. Persistent angina
      - c. Occlusion
      - d. Non-traumatic
        - (1) Recreational drugs
      - e. Trauma
  - B. Morbidity/ mortality
    - 1. Sudden death
    - 2. Extensive myocardial damage
    - 3. May result in ventricular fibrillation
      - a. Prevention strategies
        - (1) Relieve pain
        - (2) Effect reperfusion
  - C. Initial assessment findings
    - 1. Airway/ breathing
      - a. Labored breathing may or may not be present
    - 2. Circulation
      - a. Peripheral pulses
        - (1) Quality
        - (2) Rhythm
      - b. Changes in skin
        - (1) Color
        - (2) Temperature
        - (3) Moisture
  - D. Focused history
    - 1. Chief complaint
      - a. Typical onset of discomfort, usually of long duration, over 30 minutes
      - b. Typically unrelieved by rest and/ or nitroglycerin preparation
      - c. Epigastric pain or discomfort
      - d. Atypical
    - 2. Contributing history
      - a. First time
      - b. Recurrent
      - c. Increasing frequency and/ or duration

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- E. 3. Denial  
Detailed physical exam
1. Airway
  2. Breath sounds
    - a. May be clear to auscultation
    - b. Congestion in bases may be present
  3. Circulation
    - a. Skin
      - (1) Pallor during the episode
      - (2) Temperature may vary
      - (3) Diaphoresis is usually present
    - b. Alterations in heart rate and rhythm may occur
    - c. Peripheral pulses are usually not affected
    - d. Blood pressure may be elevated or lowered
    - e. ECG findings
      - (1) ST segment elevation
        - (a) Height, depth and contour
        - (b) ST changes
        - (c) ST segment depression in reciprocal leads
      - (2) Q waves
        - (a) Depth, duration and significance
          - i) Greater than 5 mm, greater than .04 seconds
          - ii) May indicate necrosis
          - iii) May indicate extensive transient ischemia
      - (3) ECG Rhythm analysis
        - (a) [Criteria for patient selection for rapid transport and reperfusion](#)
        - (b) [Value](#)
        - (c) [Signs of acute ischemia, injury, and necrosis](#)
        - (d) [Criteria for patient selection for rapid transport and reperfusion](#)
          - i) [Time of onset of pain](#)
          - ii) [Location of ischemia and infarction](#)
          - iii) [ST segment elevation](#)
      - (4) Cardiac arrhythmias
        - (a) Sinus tachycardia with or without ectopy
        - (b) Narrow or wide QRS complex tachycardia
        - (c) Sinus bradycardia
        - (d) Heart blocks
        - (e) Ventricular fibrillation
        - (f) Pulseless electrical activity (PEA)
        - (g) Asystole (confirmed in a second lead)

F. Management

1. Position of comfort
2. Pharmacological
  - a. Gases
  - b. Nitrates
  - c. Platelet aggregate inhibitor
  - d. Analgesia
  - e. Increase or decrease heart rate

- f. Possible antiarrhythmic
- g. Possible antihypertensives
- 3. Electrical
  - a. Constant ECG monitoring
  - b. Defibrillation/ synchronized cardioversion
  - c. Transcutaneous pacing
- 4. Transport
  - a. Criteria for rapid transport
    - (1) No relief with medications
      - (a) Hypotension/ hypoperfusion
      - (b) Significant changes in ECG
        - i) Ectopy
        - ii) Arrhythmias
    - b. ECG criteria for rapid transport and reperfusion
      - (1) Time of onset of pain
      - (2) ECG rhythm abnormalities
    - c. Indications for “no transport”
      - (1) Refusal
      - (2) No other indications for no-transport
  - 5. Support and communications strategies
    - (1) Explanation for patient, family, significant others
    - (2) Communications and transfer of data to the physician

IX. Heart failure

- A. Epidemiology
  - 1. Precipitating causes
    - a. Left sided failure
    - b. Right sided failure
    - b. Myocardial infarction
    - c. Pulmonary embolism
    - d. Hypertension
    - e. Cardiomegaly
    - f. High output failure
    - g. Low output failure
  - 2. Related terminology
    - a. Preload
    - b. Afterload
    - c. Congestive heart failure
      - (1) Loss of contractile ability which results in fluid overload
    - d. Chronic versus acute
      - (1) First time event
      - (2) Multiple events
- B. Morbidity/ mortality
  - 1. Pulmonary edema
  - 2. Respiratory failure
  - 3. Death
- C. Initial assessment
  - 1. Airway/ breathing

- a. Labored breathing may or may not be present
- 2. Circulation
  - a. Peripheral pulses
    - (1) Quality
    - (2) Rhythm
  - b. Changes in skin
    - (1) Color
    - (2) Temperature
    - (3) Moisture
- D. Focused history
  - 1. Chief complaint
    - a. Progressive or acute SOB
    - b. Progressive accumulation of edema
    - c. Weight gain over short period of time
    - d. Episodes of paroxysmal nocturnal dyspnea
    - e. Medication history
      - (1) Prescribed
        - (a) Compliance
        - (b) Non-compliance
      - (2) Borrowed
      - (3) Over-the-counter
    - f. Home oxygen use
- E. Detailed physical exam
  - 1. Level of consciousness
    - a. Unconscious
    - b. Altered levels of consciousness
  - 2. Airway/ breathing
    - a. Dyspnea
    - b. Productive cough
    - c. Labored breathing
      - (1) Most common, often with activity
      - (2) Paroxysmal nocturnal dyspnea (PND)
      - (3) Tripod position
      - (4) Adventitious sounds
      - (5) Retraction
  - 3. Circulation
    - a. Heart rate/ rhythm
      - (1) Any tachycardia with ectopy
      - (2) Any bradycardia with ectopy
      - (3) Atrial arrhythmias
    - b. Changes in skin
      - (1) Color
      - (2) Temperature
      - (3) Moisture
    - c. Peripheral pulses
      - (1) Quality
      - (2) Rhythm
    - d. Edema

- (1) Pitting versus non-pitting
  - (2) Extremities
    - (a) Localized in ankles
    - (b) To the midcalf
    - (c) To the knees
    - (d) Obliteration of pulses
  - (3) Ascites
    - (a) Engorged mass(es) in upper abdominal quadrants
  - (4) Sacral
- F. Complications
- 1. Pulmonary edema
    - a. Signs and symptoms
      - (1) Tachypnea
      - (2) Wheezing
      - (3) Rales at both bases
      - (4) Elevated jugular venous pressure
      - (5) Pulsus paradoxus
      - (6) Rapid "thready" pulse
      - (7) Pulsus alternans
      - (8) Abnormalities of apical pulse
        - (a) Due to displaced cardiac apex
        - (b) Abnormal bulges
      - (9) Cyanosis in advanced stages
      - (10) Frothy sputum
- G. Management
- 1. Position of comfort
  - 2. Pharmacological
    - a. Gases
    - b. Afterload reduction
    - c. Analgesia
    - d. Diuresis
    - e. Other
  - 3. Transport
    - a. Refusal
    - b. No other indications for no-transport
- H. Support and communications strategies
- 1. Explanation for patient, family, significant others
  - 2. Communications and transfer of data to the physician
- X. Cardiac tamponade
- A. Pathophysiology
    - 1. Defined as impaired diastolic filling of the heart caused by increased intrapericardiac pressure
    - 2. Precipitating causes
      - a. Gradual onset with neoplasm or infection
      - b. Acute onset with infarction
      - c. Trauma
        - (1) Can occur with CPR
        - (2) Penetrating injury

- (3) Non-penetrating injury
    - d. Secondary to renal disease
    - e. Hypothyroidism
  - B. Morbidity/ mortality
    - 1. Death if not relieved
  - C. Initial assessment
    - 1. Airway/ breathing
      - a. Labored breathing may or may not be present
    - 2. Circulation
      - a. Peripheral pulses
        - (1) Quality
        - (2) Rhythm
      - b. Changes in skin
        - (1) Color
        - (2) Temperature
        - (3) Moisture
  - D. Focused history (as in precipitating causes)
  - E. Detailed physical examination
    - 1. Airway/ breathing
      - a. Dyspnea
      - b. Orthopnea
    - 2. Circulation
      - a. Pulse rate and rhythm
      - b. Chest pain
      - c. Tachycardia
      - d. Ectopy
      - e. Elevated venous pressures (early sign)
      - f. Decreased systolic pressure (early sign)
      - g. Narrowing pulse pressure (early sign)
      - h. Pulsus paradoxus
      - i. Heart sounds normal early on, progressively faint or muffled
      - j. ECG changes
        - (1) Low voltage QRS and T waves
        - (2) ST elevation or non-specific T wave changes
        - (3) Electrical alternans of PQRST
        - (4) Usually inconclusive - should not be used as a diagnostic tool
  - F. Management
    - 1. Airway management and ventilation
    - 2. Circulation
    - 3. Pharmacological
    - 4. Non-pharmacological
    - 5. Rapid transport for pericardiocentesis
  - G. Support and communications strategies
    - 1. Explanation for patient, family, significant others
    - 2. Communications and transfer of data to the physician
- XI. Hypertensive emergencies
  - A. Epidemiology

1. Precipitating causes
  - a. History of hypertension
  - b. Non-compliance with medication or any other treatment
  - c. Toxemia of pregnancy
- B. Morbidity/ mortality
  - a. Hypertensive encephalopathy
  - b. Stroke
- C. Initial assessment
  1. Airway/ breathing
    - a. Labored breathing may or may not be present
  2. Circulation
    - a. Peripheral pulses
      - (1) Quality
      - (2) Rhythm
    - b. Changes in skin
      - (1) Color
      - (2) Temperature
      - (3) Moisture
- D. Focused history
  1. Chief complaint
    - a. As in precipitating causes above
  2. Medication history
    - a. Prescribed
      - (1) Compliance
      - (2) Non-compliance with medication or treatment
    - b. Borrowed
    - c. Over-the-counter
  3. Home oxygen use
- E. Detailed physical examination
  1. Airway
  2. Breath sounds
  3. Circulation
    - a. Pulse
    - b. Vital signs
      - (1) Blood pressure
        - (a) Systolic greater than 160 mmHg
        - (b) Diastolic greater than 94 mmHg
  4. Diagnostic signs/ symptoms
    - a. General appearance
    - b. Level of consciousness
      - (1) Unconscious
      - (2) Altered level of consciousness
      - (3) Responsive
    - c. Skin color
      - (1) Can be pallor, flushed, or normal
    - d. Skin hydration
      - (1) Can be dry or moist
    - e. Skin temperature

- (1) Can be warm or cool
    - f. Peripheral pulses
      - (1) Can be strong
    - g. Edema
      - (1) Pitting versus non-pitting
    - h. Paroxysmal nocturnal dyspnea
    - i. Labored breathing (SOB)
    - j. Orthopnea
    - k. Vertigo
    - l. Epistaxis
    - m. Tinnitus
    - n. Changes in visual acuity
    - o. Nausea/ vomiting
    - p. Seizures
    - q. Lateralizing signs
    - r. ECG findings
  - F. Management
    - 1. Non-pharmacologic
      - a. Position of comfort
      - b. Airway and ventilation
    - 2. Pharmacological
      - a. Gases
      - b. Other
    - 3. Rapid transport
      - a. Refusal
      - b. No other indications for no transport
  - G. Support and communications strategies
    - 1. Explanation for patient, family, significant others
    - 2. Communications and transfer of data to the physician
- XII. Cardiogenic shock
  - A. Pathophysiology
    - 1. Precipitating causes
      - a. Myocardial infarction
        - (1) Can be acute or progressive
      - b. Age
        - (1) Progressive
      - c. Trauma
  - B. Initial assessment
    - 1. Airway/ breathing
      - a. Labored breathing may or may not be present
    - 2. Circulation
      - a. Peripheral pulses
        - (1) Quality
        - (2) Rhythm
      - b. Changes in skin
        - (1) Color
        - (2) Temperature

- (3) Moisture
- C. Focused history
  - 1. Chief complaint
    - a. As in precipitating causes above
  - 2. Medication history
    - a. Prescribed
      - (1) Compliance
      - (2) Non-compliance
    - b. Borrowed
    - c. Over-the-counter
- D. Detailed physical exam
  - 1. Critical findings
    - a. Unconscious
    - b. Altered levels of consciousness
    - c. Airway
      - (1) Dyspnea
      - (2) Productive cough
      - (3) Labored breathing
        - (a) Paroxysmal nocturnal dyspnea (PND)
        - (b) Tripod position
        - (c) Adventitious sounds
        - (d) Retraction
    - d. ECG rhythm analysis
      - (1) Any tachycardia
      - (2) Atrial arrhythmias
      - (3) Ectopics
    - e. Changes in skin
      - (1) Color
      - (2) Temperature
      - (3) Moisture
    - f. Peripheral pulses
      - (1) Quality
      - (2) Rhythm
    - g. Edema
      - (1) Pitting versus non-pitting
      - (2) Extremities
        - (a) Obliteration of pulses
      - (3) Sacral
- E. Management
  - 1. Position of comfort
    - a. May prefer sitting upright with legs in dependent position
  - 2. Pharmacological
    - a. Gases
    - b. Vasopressor
    - c. Analgesia
    - d. Diuretics
    - e. Glycoside
    - f. Sympathetic agonist

- g. Alkalinizing agent
      - h. Other
  - F. Transport
    - 1. Refusal
    - 2. No other indications for no transport
  - G. Support and communications strategies
    - 1. Explanation for patient, family, significant others
    - 2. Communications and transfer of data to the physician
- XIII. Cardiac arrest
  - A. Pathophysiology
    - 1. Precipitating causes
      - a. Trauma
      - b. Medical conditions (for example)
        - (1) End stage renal disease
        - (2) Hyperkalemia with renal disease
  - B. Initial assessment
    - 1. Critical findings
      - a. Unresponsive
      - b. Apneic
      - c. Heart rate/ rhythm
        - (1) Ventricular fibrillation
        - (2) Ventricular tachycardia
        - (3) Asystole
        - (4) PEA
      - d. Peripheral pulses
        - (1) None
  - C. Focused history
    - 1. Witnessed event
    - 2. Witnessed by EMS personnel
    - 3. Bystander cardiopulmonary resuscitation (CPR)
    - 4. Time from discovery to activation of CPR
    - 5. Time from discovery to activation of EMS
    - 6. Past medical history
  - D. Management
    - 1. Related terminology
      - a. Resuscitation - to provide efforts to return spontaneous pulse and breathing to the patient in full cardiac arrest
      - b. Survival - patient is resuscitated and survives to hospital discharge
      - c. Return of spontaneous circulation (ROSC) - patient is resuscitated to the point of having pulse without CPR; may or may not have return of spontaneous respirations; patient may or may not go on to survive
    - 2. Indications for NOT initiating resuscitative techniques
      - a. Signs of obvious death
        - (1) For example - rigor; fixed lividity; decapitation
      - b. Local protocol
        - (1) For example - out-of-hospital advance directives
    - 3. Advanced airway management and ventilation

4. Circulation
  - a. CPR in conjunction with defibrillation
  - b. IV therapy
  - c. Defibrillation
  - d. Pharmacological
    - (1) Gases (oxygen)
    - (2) Sympathetic
    - (3) Anticholinergic
    - (4) Antiarrhythmic
    - (5) Vasopressor
    - (6) Alkalinizing agents
    - (7) Parasympatholytic
5. Rapid transport
6. Support and communications strategies
  - a. Explanation for patient, family, significant others
  - b. Communications and transfer of data to the physician
- E. Termination of resuscitation
  1. Inclusion criteria (for example)
    - a. 18 years old or older
    - b. Arrest is presumed cardiac in origin and not associated with a condition potentially responsive to hospital treatment (for example - hypothermia, drug overdose, toxicologic exposure, etc.)
    - c. Endotracheal intubation has been successfully accomplished and maintained
    - d. Standard advanced cardiac life support (ACLS) measures have been applied throughout the resuscitative effort
    - e. On-scene ALS resuscitation efforts have been sustained for 25 minutes or the patient remains in asystole through four rounds of appropriate ALS drugs
    - f. Patient has a cardiac rhythm of asystole or agonal rhythm at the time the decision to terminate is made and this rhythm persists until the arrest is actually terminated
    - g. Victims of blunt trauma in arrest whose presenting rhythm is asystole, or who develop asystole while on scene
  2. Exclusion criteria - for example
    - a. Under the age of 18 years
    - b. Etiology for which specific in-hospital treatment may be beneficial
    - c. Persistent or recurrent ventricular tachycardia or fibrillation
    - d. Transient return of pulse
    - e. Signs of neurological viability
    - f. Arrest was witnessed by EMS personnel
    - g. Family or responsible party opposed to termination
  3. Criteria NOT to be considered as inclusionary or exclusionary
    - a. Patient age - for example, geriatric
    - b. Time of collapse prior to EMS arrival
    - c. Presence of a non-official do-not-resuscitate (DNR) order
    - d. "Quality of life" valuations
  4. Procedures (according to local protocol)
    - a. Direct communication with on-line medical direction
      - (1) Medical condition of the patient
      - (2) Known etiologic factors

- (3) Therapy rendered
- (4) Family present and apprised of the situation
- (5) Communicate any resistance or uncertainty on the part of the family
- (6) Maintain continuous documentation to include the ECG
- (7) Mandatory review after the event
  - (a) Grief support (according to local protocol)
    - i) EMS assigned personnel
    - ii) Community agency referral
  - (b) Law enforcement (according to local protocol)
    - i) On-scene determination if the event/ patient requires assignment of the patient to the medical examiner
    - ii) On-scene law enforcement communicates with attending physician for the death certificate
    - iii) If there is any suspicion about the nature of the death, or if the physician refuses or hesitates to sign the death certificate
    - iv) No attending physician is identified (the patient will be assigned to the medical examiner)

XIV. Vascular disorders

A. Epidemiology

1. Trauma

2. Non-traumatic

a. Precipitating causes

(1) Atherosclerosis

(2) Aneurysm

(a) Atherosclerotic

(b) Dissecting

i) Cystic medial necrosis

(c) Infections

(d) Congenital

(3) Marfan's syndrome

(4) Inflammation

(a) Arterial

(b) Peripheral arterial atherosclerotic disease

(5) Occlusive disease

(a) Trauma

(b) Thrombosis

(c) Tumor

(d) Embolus

(e) Idiopathic

(6) Venous thrombosis

(a) Phlebitis

(b) Varicose veins

B. Morbidity/ mortality

1. Pulmonary occlusion

2. Cerebral occlusion

3. Mesenteric occlusion

4. Hypoperfusion state
5. Death
- C. Initial assessment findings
  1. Airway/ breathing
    - a. Usually not affected
  2. Circulation (distal to or over the affected area)
    - a. Pain
    - b. Pallor
    - c. Pulselessness
    - d. Paralysis
    - e. Paresthesia
  3. Skin
    - a. Pallor or mottled distal to or over the affected area
    - b. Skin temperature may vary
- D. Focused history
  1. Chief complaint
    - a. Sudden or gradual onset of discomfort
    - b. May be localized
    - c. Pain
      - (1) Chest, abdominal or involved extremity
        - (a) Sudden or gradual
        - (b) Radiating or localized
        - (c) Claudication
      - (2) Relief with rest or not
  2. Contributing history
    - a. Initial recognized event
    - b. Recurrent event
    - c. Increasing frequency and/ or duration of event
- E. Detailed physical exam
  1. Airway
  2. Breath sounds
    - a. May be clear to auscultation
  3. Circulation
    - a. Alterations in heart rate and rhythm may occur
    - b. Peripheral pulses absent or diminished over the affected extremity
    - c. Blood pressure
      - (1) Unequal BP readings in each arm
        - (a) May indicate high thoracic aneurysm
    - d. Bruit over affected vessel(s)
    - e. Skin
      - (1) May be cool reflecting diminished circulation to the affected area or extremity
      - (2) May be moist or dry reflecting diminished circulation to the affected area or extremity
    - f. ECG findings may be non contributory
      - (1) Arrhythmias and ectopy may not be present
  4. Management
    - a. Position of comfort

- b. Pharmacological
  - (1) Gases
  - (2) Analgesics
- c. Transport
  - (1) Indications for rapid transport
    - (a) No relief with medications
    - (b) Hypotension/ hypoperfusion
  - (2) No transport
    - (a) Refusal
    - (b) Relief and refusal
- d. Support and communications strategies
  - (1) Explanation for patient, family, significant others
  - (2) Communications and transfer of data to the physician

XV. Integration

- A. Apply pathophysiological principles to the assessment of a patient with cardiovascular disease
- B. Formulation of field impression; decisions based on
  - 1. Initial assessment
  - 2. Focused history
  - 3. Detailed physical examination
- C. Develop and execute a patient management plan based on field impression
  - 1. Initial management
    - a. Airway support
    - b. Ventilation support
    - c. Circulation support
    - d. Non-pharmacological
    - e. Pharmacological
    - f. Electrical
  - 2. On-going assessment
  - 3. Transport criteria
    - a. Appropriate mode
    - b. Appropriate facility
  - 4. Non-transport criteria
  - 5. Advocacy
  - 6. Communications
  - 7. Prevention
  - 8. Documentation
  - 9. Quality assurance

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